

A REVIEW OF THE NORTH AMERICAN SPECIES OF *MEGARCYS* KLAPÁLEK (PLECOPTERA: PERLODIDAE)

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Abstract.—The arcynopterygine genus *Megarcys* in North America is reviewed. Five species, *M. irregularis* (Banks), *M. signata* (Hagen), *M. subtruncata* Hanson, *M. watertoni* (Ricker) and *M. yosemite* (Needham and Claassen) are recognized. New illustrations for the males and females and a key to species are presented. Scanning electron photomicrographs of the eggs are given.

Key Words: Plecoptera, Perlodidae, *Megarcys*, North America

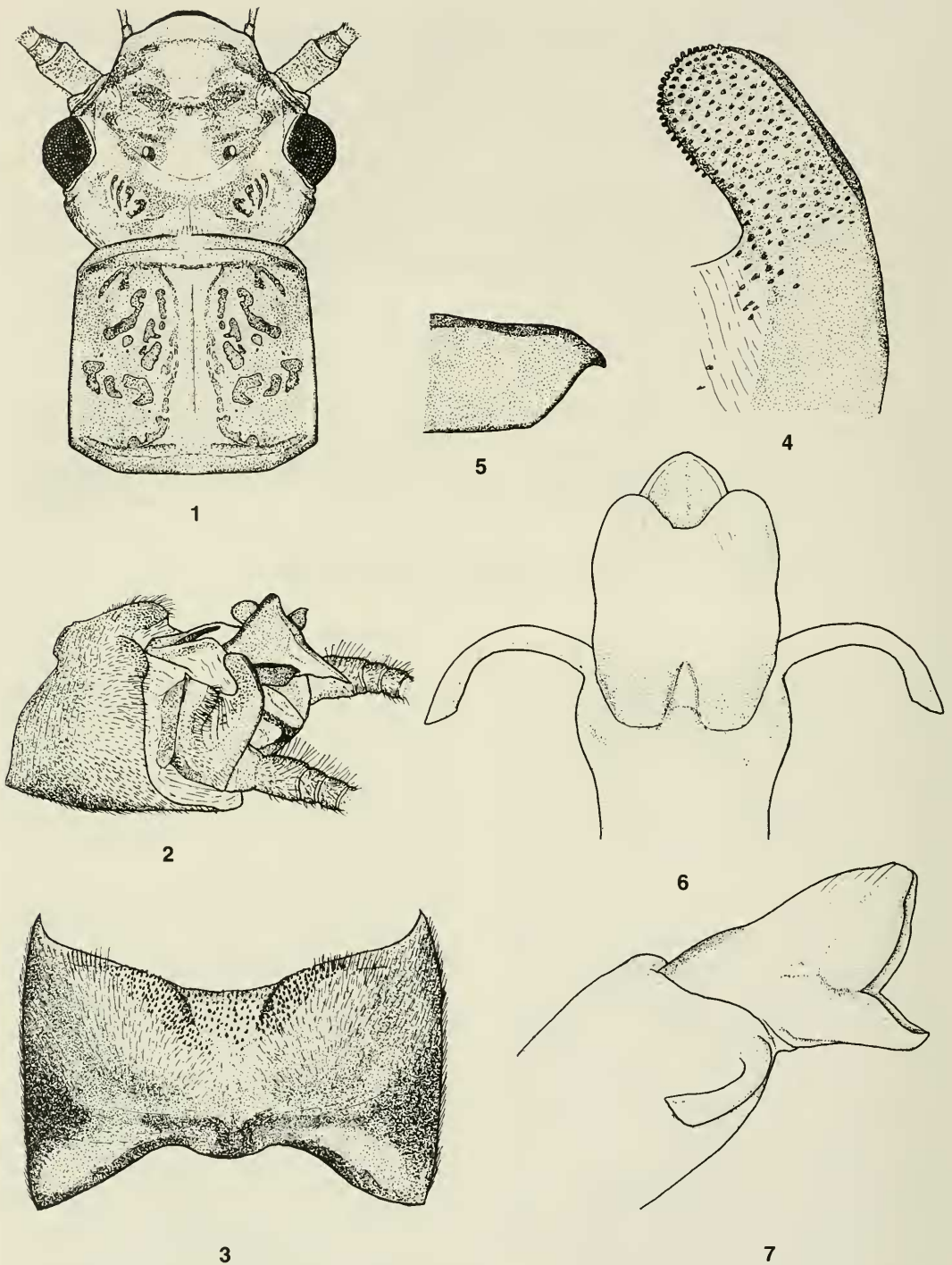
The arcynopterygine genus *Megarcys* in North America (Stark and Szczytko 1988) has had a complex taxonomic history since the original description of *Dictyopteryx signata* by Hagen in 1874. Currently, five species are recognized from North America (Stark 1998), following Ricker's (1952) evaluation of the group. However, as Ricker pointed out "they could be treated almost equally as species, or as subspecies of Hagen's *signata*." Hanson's (1942) review of *Megarcys* recognized only two species, *M. signata* and his new species, *M. subtruncata*. A current survey of the stoneflies of Mt. Rainier National Park, Washington, the type locality of two species, *M. irregularis* (Banks) and *M. subtruncata*, and the occurrence of *M. yosemite* (Needham and Claassen), has provided material for a review of the genus in North America, and comparative descriptions and illustrations of the five North American species.

MATERIALS AND METHODS

Specimens examined in this study are housed in the collections of the Monte L.

Bean Life Science Museum, Brigham Young University (BYU), C.P. Gillette Museum of Arthropod Biodiversity, Colorado State University (CSU); Cornell University (CU); Illinois Natural History Survey (INHS); and the B. P. Stark Collection (BPSC).

Illustrations were made of the male terminalia, head and prothorax, and female subgenital plates using a camera lucida. Techniques of Stark and Szczytko (1981) were used to prepare photomicrographs of eggs. Terminology used for describing adult morphological characters and eggs follow Stark and Szczytko (1988). We have used the term "windsock-like" for the description of the posterior process (ventral epiproct surface) of the aedeagus. This term was used by Stark et al. (1998). The aedeagus of three of the species, *M. irregularis*, *M. signata* and *M. yosemite* are illustrated for future comparisons, but are not used to distinguish taxa. The holotypes of *M. irregularis*, *M. signata*, and *M. subtruncata* were not examined, since the identity of these species were not in doubt.



Figs. 1-7. *Megarcys signata*. 1, Male head and prothorax, dorsal. 2, Male terminalia, oblique view. 3, 9th tergum, dorsal. 4, Hemitergal lobe, lateral. 5, Lateral stylet, apex. 6, Aedeagus, dorsal. 7, Aedeagus, lateral.

Megarcys signata (Hagen)

(Figs. 1–7, 32, 37–40)

Dictyopteryx signata Hagen 1874: 576.

Type locality, Colorado. Holotype ♂, MCZ, not examined.

Megarcys signata: Hanson (in part), 1941: 398.*Arcynopteryx (Megarcys) signata*: Ricker 1952: 75.*Megarcys signata*: Illies 1966: 371.

Diagnosis.—The male of *M. signata* can be distinguished from the cognate species *M. irregularis* by presence of numerous spinule in the median cleft of the 9th tergum (Fig. 3). The female of *M. signata* is also very similar to *M. irregularis*, but can be usually separated by the subgenital plate produced $\frac{1}{2}$ or more length of 9th sternum (Fig. 32). General color brown. Head with dark rugosities medially and posterior to the compound eyes, darker V-shaped pattern encompassing anterior ocellus; pale mid-dorsal stripe on prothorax (Fig. 1).

Male.—Length of forewing 10–16 mm, body 15–18 mm. Anterior (dorsal) surface of epiproct sclerotized, posterior (ventral) surface windsock-like with narrowly rounded anterodorsal hump, apex acutely tapered, not decurved at tip (Fig. 2). Hemitergal lobes U-shaped, greater than $1\frac{1}{2}\times$ as long as wide (Figs. 2, 4), bluntly rounded with spinules covering entire tip; lateral stylet with forward directed spine (Fig. 4). Ninth tergum swollen submedially, divided by median cleft, spinules covering entire cleft (Figs. 2–3). Aedeagus socklike, constricted about $\frac{2}{3}$ distally (Figs. 6–7); apical lobe with basal setal patch dorsally, apically with deep evagination, lateral tubular processes extend proximally from basal lobe (Fig. 6).

Female.—Length of forewing 18–21 mm, body 20–21 mm. Subgenital plate produced to $\frac{1}{2}$ or more of the 9th sternum, rounded with median cleft usually widest posteriorly (Fig. 32).

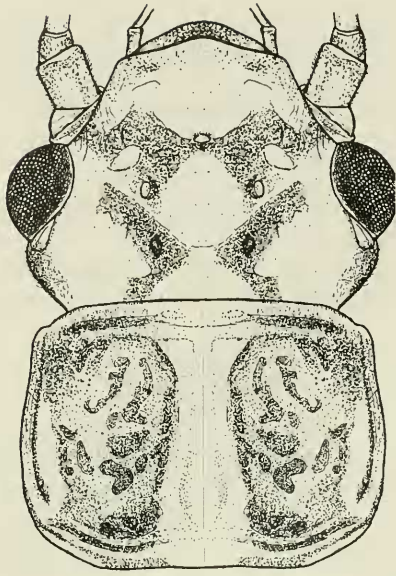
Egg.—Collar stalked, rim usually deeply and irregularly incised, posterior surface of shoulder with ornate processes (Figs. 37–

38). Chorion covered with irregular deep pits without hexagonal pattern; surface irregularly indented including posterior pole (Figs. 38–40); micropylar row subequatorial, ecolosion line absent (Fig 37).

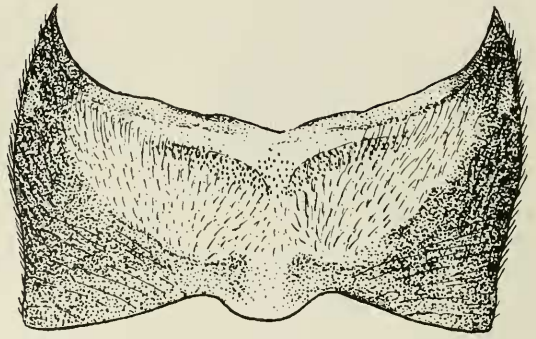
Distribution.—*Megarcys signata*, a widespread western North American species, can be common in small to medium sized high elevation streams of AK, BC, CO, ID, MT, NM, NV, UT, and WY (Stark 1998). In Colorado, this large predatory stonefly species is often found with *Kogotus modestus* (Banks) above 3,300 m.

Remarks.—Stark and Szczytko (1988) provided good descriptions of the male terminalia and eggs of this species. All the known biological information for North American *Megarcys* refers to *M. signata* (see references cited by Stewart and Stark 1988). Recently, Taylor et al. (1999) reported that this species is semivoltine with delayed egg hatch. The nymph has been described in detail by Stewart and Stark (1988).

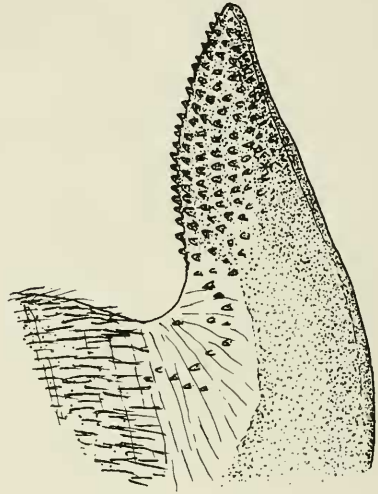
Material examined.—COLORADO: Boulder Co., Middle St. Vrain, FR. 114 W. of Peaceful Valley, 17 July 1993, B. Kondratieff and W. Painter, 1 ♂ (CSU); Boulder Co., Trib. to Jasper Cr., Indian Peaks Wild, 12 September 1998, B. Kondratieff, 1 ♀ (CSU); Eagle Co., Deep Cr., 17 Rd., 27 June 1997, B. Kondratieff, 2 ♂, 7 ♀ (CSU); Gilpin Co., South Boulder Cr., Rollinsville, 19 June 1986, B. Kondratieff, 7 ♂, 2 ♀ (CSU); Gilpin Co., South Boulder Cr., 2 mi. W. Tolland, 7 July 1991, B. Kondratieff and R. Durfee, 12 ♂, 6 ♀ (CSU); Grand Co., Fraser R., above Robbers Roost Camp., 5 August 1973, R.W. Baumann, B.P. Stark, 11 ♂, 3 ♀ (BYU); Grand Co., Timber Cr., Backcountry campsite, RMNP, 26 July 1989, C. Barker and M. Harris, 5 ♀ (CSU); Grand Co., W. St. Louis Cr., Fraser Exp. Forest, 24 July 1999, H. Rhodes, 1 ♂ (CSU); Gunnison Co., East R., near Avery campground, 13 August 1986, B. Armitage, 1 ♂, 1 ♀ (CSU); Gunnison Co., tribs. to Oh-Be Joyful Cr., Rt. 754, 14 August 1996, B. Kondratieff and N. Lorenzon, 1 ♂, 1 ♀



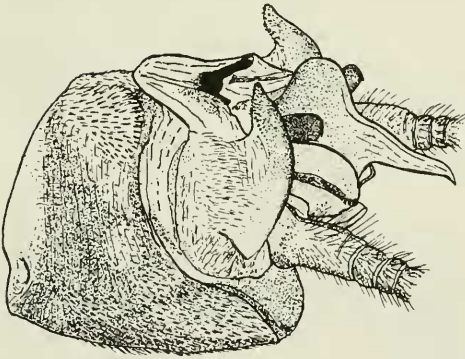
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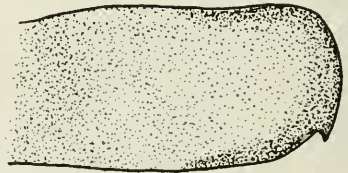
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Figs. 8–12. *Megarcys subtruncata*. 8, Male head and prothorax, dorsal. 9, Male terminalia, oblique view. 10, 9th tergum, dorsal. 11, Hemitergal lobe, lateral, 12, Lateral stylet, apex.

(CSU); Hinsdale Co., Silver Cr., Redcloud Pk., 1 August 1992, B. Kondratieff, 1 ♀ (CSU); Hinsdale Co., Silver Cr., Silver Cr. Tr. 2 mi. from trailhead, 12,000 ft., 5 September 1993, B. Kondratieff and R. Durfee,

1 ♂, 1 ♀ (CSU); Hinsdale Co., Silver Cr. 12,000 ft., Redcloud Peak, 10 September 1993, S. Fitzgerald and T. Eckberg, 1 ♂, 3 ♀ (CSU); Hinsdale Co., Silver Cr. 12,000 ft., Redcloud Peak, 13 August 1995, S.

Fitzgerald and A. Foley, 1 ♂ (CSU); Hinsdale Co., Nellie Cr. 12,000 ft., 1 August 1997, A. Ellingson, 1 ♀ (CSU); Hinsdale Co., Cataract Gulch 9,700 ft., 10 July 1998, A. Ellingson, 1 ♀ (CSU); Jackson Co., Michigan R., off Rt. 14 Lake Agnes, 2 August 1986, B. Kondratieff, 1 ♀ (CSU); Jackson Co., Michigan R., by Lake Agnes Rd., 17 July 1987, B. Kondratieff, 1 ♀ (CSU); Larimer Co., Spruce Cr. 9,700 ft., RMNP, 29 July 1989, M. Harris and M. Scott, 1 ♂ (CSU); Larimer Co., Skin Gulch, Stove Prairie Rd. 1 mi. S. of Hwy. 14, 8 May 1993, B. Kondratieff and R. Durfee, 1 ♀ (CSU); Larimer Co., Rawah Wilderness outlet Cr. Twin Crater Lakes 10,800–11,000 ft., 17 September 1995, S. Fitzgerald and A. Foley, 3 ♂, 5 ♀ (CSU); Park Co., Four-mile Cr., 17 km W Pairplay, 13 July 2000, H. e. Evans, 4 ♂, 2 ♀ (CSU); Pitkin Co., Independence Pass, Mt. Boy Park., 6 August 1943, J.A.R. and H.H. Ross, 1 ♂, 3 ♀ (BYU); Summit Co., Clear Cr., near Loveland Pass., 8, August 1973, R.W. Baumann and B. P. Stark, 1 ♂ (BYU); Summit Co., Cr. in Avalanche Chute, W. side Peak 5, 2 September 1995, S. Fitzgerald and A. Foley, 1 female (CSU); Summit Co., Union Cr., Copper Mt., 6 July 1997, B. Kondratieff, 1 ♀ (CSU); MONTANA: Gallatin Co., Pine Cr., 3.5 mi. off Trail Cr. Rd., 10 June 1987, B. Kondratieff and F. Kirchner, 5 ♂, 4 ♀ (CSU); Glacier Co., Piegan Cr., Glacier N.P., 8 May 1965, A.R. Gaufin, 1 ♂ (BYU); Granite Co., Ranch Cr. at Grizzly Campground, 19 June 1967, M.L. Miner, 1 ♂ (BYU); UTAH: Salt Lake Co., Millcreek Canyon Cr. at Log Haven, 12 May 1966, R.W. Baumann, 3 ♂, 2 ♀ (BYU); Utah Co., Stewarts Cr. Sundance Ski Area, 10 July 1986, R.W. Baumann and R. Nelson, 2 ♂ (BYU); Utah Co., Summit Cr. Tinney Flat Campground, Santaquin Canyon., 25 June 1998, S.M. Clark, 1 ♂, 1 ♀ (BYU); WYOMING: Sheridan Co., Whedon Spring at Hwy 14A, 25 July 1998, D. Ruiter, 1 ♀ (CSU); Sublette Co., Bull Cr., Rt. 191/189 mile marker 153, 11 June 1987, B. Kondratieff, 1 ♂ (CSU); Teton Co., Granite Cr.

Falls, Bridger Teton N.F., 18 July 1999, P. Opler, 3 ♀ (CSU); CANADA: ALBERTA, Lake Louise, W.W. Baniff N.P., 26 July 1987, J. Rabold, 1 ♀ (CSU).

Megarcsys subtruncata Hanson
(Figs. 8–12, 36, 41–44)

Megarcsys subtruncata Hanson 1942: 400.
Type locality: Paradise Valley, Mt. Rainier National Park, Washington. Holotype ♂, USNM, not examined.

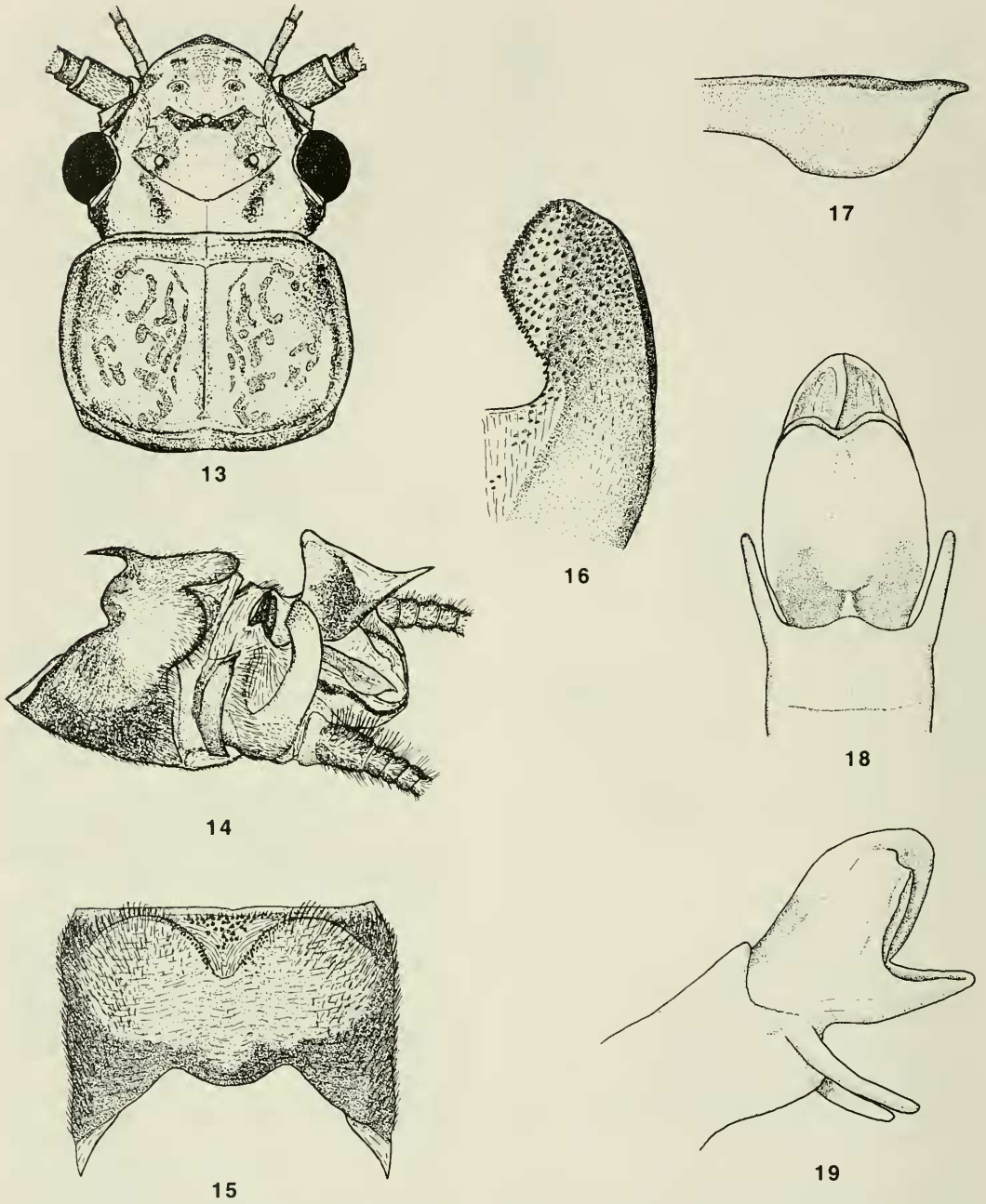
Arcynopteryx (Megarcsys) subtruncata:
Ricker 1952: 75.

Megarcsys subtruncata: Illies 1966: 371.

Diagnosis.—The combination of the acute apex of the hemitergal lobe and truncate apex of the lateral stylet easily distinguish the male of *M. subtruncata* from *M. watertoni* and *M. yosemite*. The female of *M. subtruncata* is very similar to *M. watertoni*. The subgenital plate of *M. subtruncata* usually covers less than ½ of sternum 9, whereas the subgenital plate of *M. watertoni* usually covers ½ or more of sternum 9. General color dark brown. Head with distinct wide V-shaped pattern posterior to lateral ocelli, an inverted U-shaped pattern connecting ocelli; pale prothorax middorsal stripe (Fig. 8).

Male.—Length of fore wing 13–16 mm, body 17–21 mm. Posterior surface of epi-proct windsock-like with broadly rounded anterodorsal hump; apex tapered and decurved at tip (Fig. 9). Ninth tergum swollen, submedially divided by median cleft, spinules sparse in cleft, dense on swollen areas (Fig. 10). Hemitergal lobes U-shaped, distal arm 2× longer than wide, apex of distal arm acute, twisted medially, spinules covering entire arm (Figs. 9, 11). Lateral apex of stylets blunt, subparallel, subacute process on ventral half (Figs. 9, 12).

Female.—Length of fore wing 19–20 mm, body 19–25 mm. Subgenital plate extends to ¼ or less of 9th sternum, rounded with small median cleft, cleft sometimes absent, if present, not reaching anteriorly to the posterior edge of 8th sternum (Fig. 36).



Figs. 13-19. *Megarcys irregularis*. 13, Male head and prothorax, dorsal. 14, Male terminalia, oblique view. 15, 9th tergum, dorsal. 16, Hemitergal lobe, lateral. 17, Lateral stylet, apex. 18, Aedeagus, dorsal. 19, Aedeagus, lateral.

Egg.—Collar stalked, rim usually deeply and irregularly incised; posterior surface of shoulder with ornate processes (Figs. 41, 42). Chorion with irregular deep pits without hexagonal pattern; surface irregularly indented; posterior pole rounded (Figs. 42–44); micropylar row subequatorial; eclosion line absent (Fig. 41).

Distribution.—Cascade Mountains and Northern Rocky Mountains of BC, ID, MT, OR and WN (Stark 1998).

Remarks.—This species is common in most streams of Mt. Rainier National Park, often sympatric with *M. irregularis*.

Material examined.—OREGON: Hood River Co., Upper Elk Cr. Near Lolo Pass, 12 June 1983, G.R. Fiala, 1 ♂ (BYU); WASHINGTON: Lewis Co., Skate Cr., 4150 Skate Cr. Rd., G. Pinchot N.F., 28 May 1997, B. Kondratieff, 11 ♂, 2 ♀ (CSU); Lewis Co., Ohanapecosh R., Grove of the Patriarchs, Mt. Rainier N.P., 28 May 1997, B. Kondratieff, 1 ♂ (CSU); Pierce Co., Deer Cr., Rt. 123, Mt. Rainier N.P., 27 May 1997, B. Kondratieff, 2 ♂ (CSU); Pierce Co., Panther Cr., Rt. 123, Mt. Rainier N.P., 29 May 1997, B. Kondratieff, 1 ♂ (CSU); Pierce Co., Goat Cr., Rt. 410, 29 May 1997, B. Kondratieff, 4 ♂, 1 ♀ (CSU); Pierce Co., Glacier Basin, Mt. Rainier N.P., 20 July 1997, R. Lechleitner, 4 ♀ (CSU); Pierce Co., Glacier Basin, Mt. Rainier N.P., 21 July 1997, R. Lechleitner, 1 ♂, 11 ♀ (CSU); Pierce Co., Frying Pan Cr., Sunrise Rd. Mt. Rainier N.P., 6 July 1999, B. Kondratieff, 1 ♂, 1 ♀ (CSU); Pierce Co., Paradise R. above Narada Falls, Mt. Rainier N.P., 16 August 1999, B. Kondratieff, R. Lechleitner, 2 ♀ (CSU); Pierce Co., Frying Pan Cr., Sunrise Rd. Mt. Rainier N.P., 16 August 1999, B. Kondratieff, 1 ♀ (CSU); Skamania Co., Cr. near June Lake, Mt. St. Helens, 12 July 1997, S. Fitzgerald, A. Foley, 8 ♀ (CSU); Whatcom Co., Wells Cr. Falls jct. of Bar Cr. and Wells Cr., 14 July 1988, R.W. Baumann, S. Wells and M. Whiting, 1 ♂ (BYU); Yakima Co., Union Cr. 20 miles W. Cliffdell, 27 June 1971, D. Loreth, 1 ♂ (BYU).

Megarcys irregularis (Banks)

(Figs. 13–19, 35, 45–48)

Dictyoptyeryx irregularis Banks 1900: 243.

Type locality: Mt. Rainier National Park, Washington. Holotype ♀, MCZ, not examined.

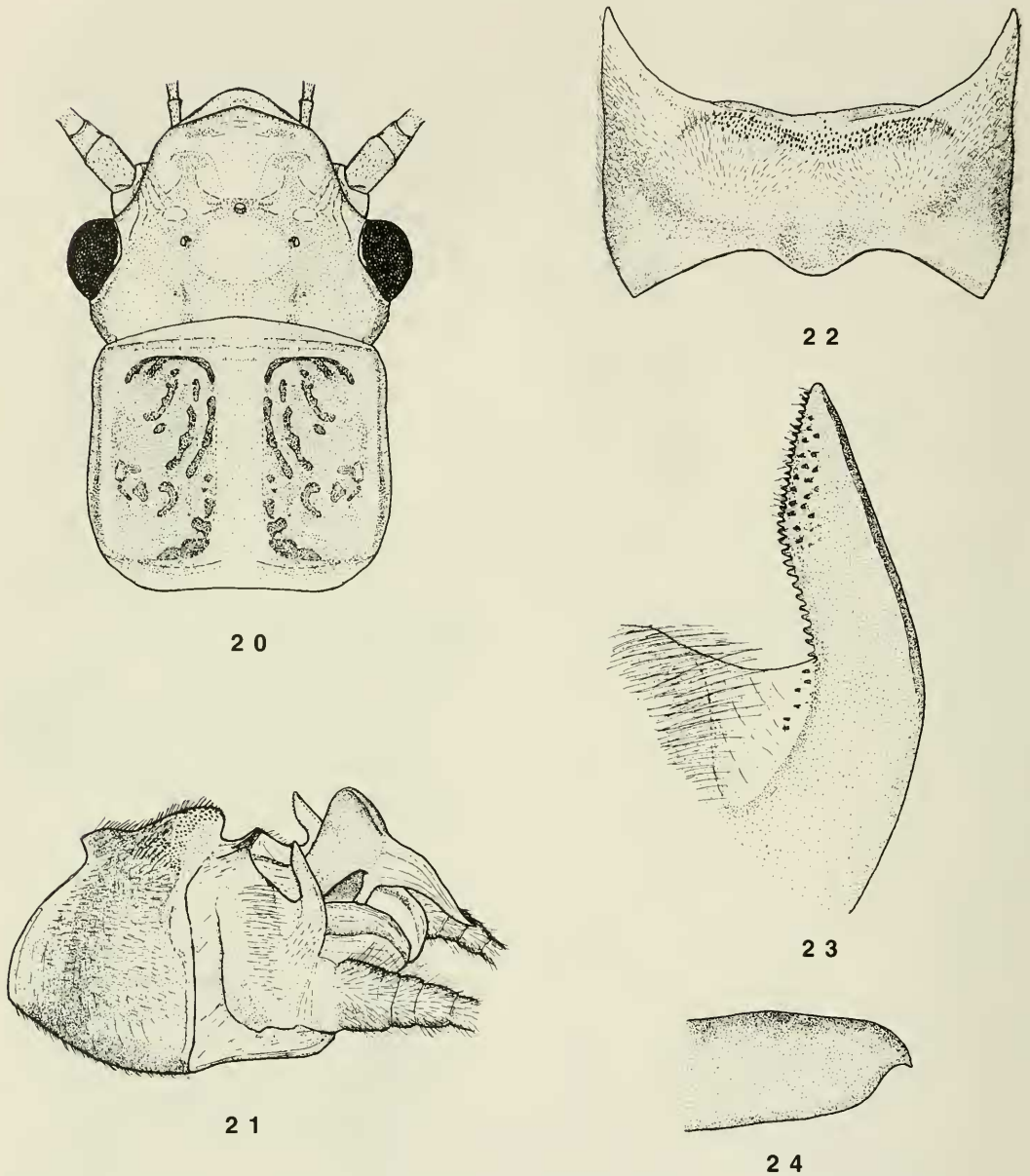
Arcynopteryx (Megarcys) irregularis: Rick-er 1952: 75.

Megarcys irregularis: Illies 1966:370.

Diagnosis.—The male of *M. irregularis* is very similar to *M. signata* but can be distinguished by the lack of spinule in the median cleft of the 9th tergum. Females of both species are similar, but the characters given used in the key, the length of the subgenital plate and chorion pattern of the eggs usually allow separation. General color brown. Head with an inverted U-shaped mark between compound eyes; pale mid-dorsal line on prothorax (Fig. 13).

Male.—Length of fore wing 15–16 mm, body 18–20 mm. Posterior surface of epiproct windsock-like with narrowly rounded anterodorsal hump, apex tapered to tip (Fig. 14). Ninth tergum swollen submedially, divided by median cleft; spinule patch distal to median cleft, spinules sparse around edges of cleft and swollen areas (Fig. 15). Hemitergal lobes U-shaped, with distal arm 1½× longer than wide, distal arm blunt, twisted medially, spinules covering entire apex, sparsely covering membranous portion of lobe (Figs. 14, 16). Lateral stylelets expanded towards tip, with a terminal process pointing posteriorly (Figs. 14, 17). Aedeagus sock-like constricted about ⅓ distally, setal patch basal and dorsally on apical lobe, evagination on proximal end of apical lobe (Figs. 18, 19); lateral tubular processes directed ventral and distal, margin of basal lobe (Fig. 19).

Female.—Length of fore wing 20–21 mm, body 21–23 mm. Subgenital plate prolonged to cover ½ or less of the 9th sternum and rounded posteriorly; medial cleft reaching anteriorly to the posterior margin of 8th sternum, cleft narrow posteriorly, expanded, oval-shaped anteriorly (Fig. 35).



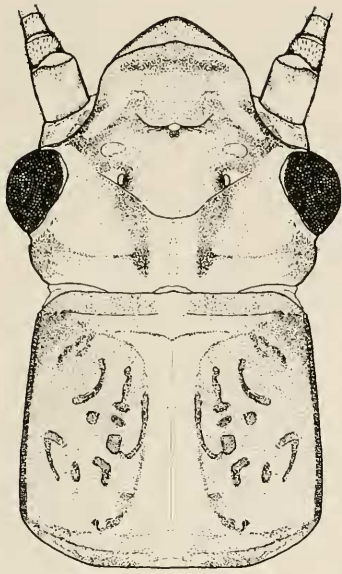
Figs. 20–24. *Megarcys watertoni*. 20, Male head and prothorax, dorsal. 21, Male terminalia, oblique view. 22, 9th tergum, dorsal. 23, Hemitergal lobe, lateral. 24, Lateral stylet, apex.

Egg.—Collar stalked, rim usually deeply and irregularly incised; posterior surface of shoulder with ornate processes (Figs. 45, 46). Chorion covered with irregular hexagonal follicle cell impressions, chorionic folds absent or obscure (Figs. 46–48); mi-

crophyllar row subequatorial; eclosion line absent (Fig. 45).

Distribution.—Coast and Cascade Mountains of BC and WN (Stark 1998).

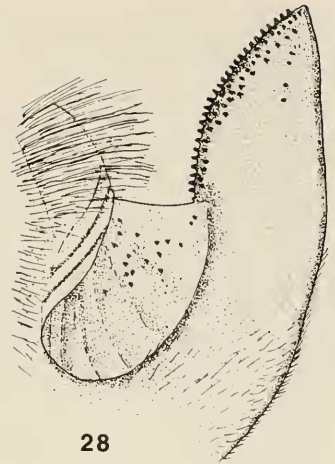
Remarks.—Other than *M. yosemite*, this species seems to have the most restricted



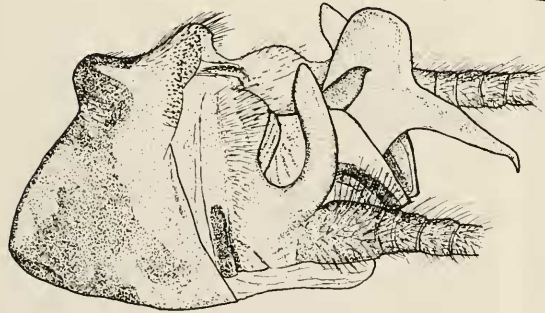
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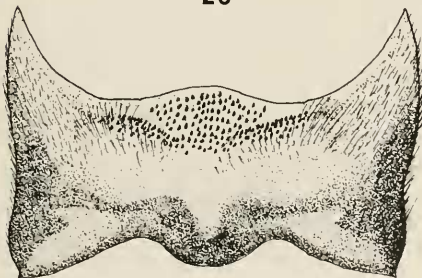
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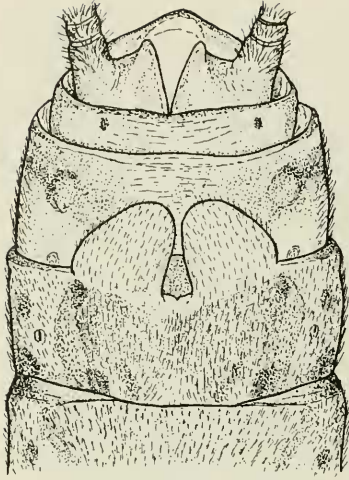


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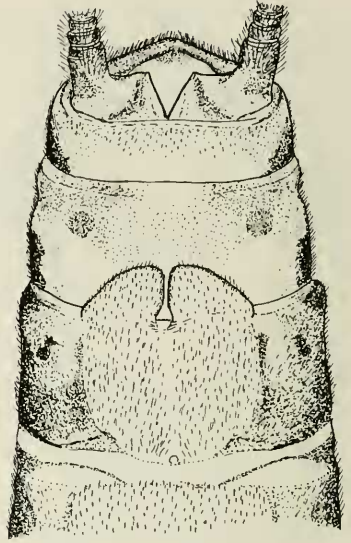


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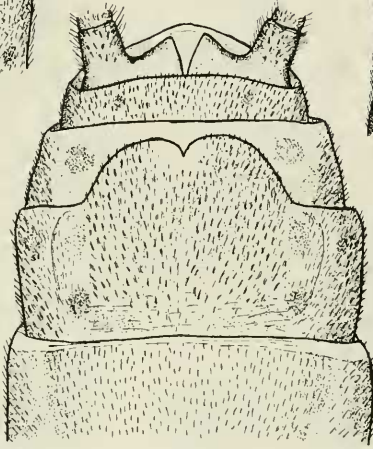
Figs. 25–31. *Megarcys yosemite*. 25, Male head and prothorax, dorsal. 26, Male terminalia, oblique view. 27, 9th tergum, dorsal. 28, Hemitergal lobe, lateral. 29, Lateral stylet, apex. 30, Aedeagus, dorsal. 31, Aedeagus, lateral.



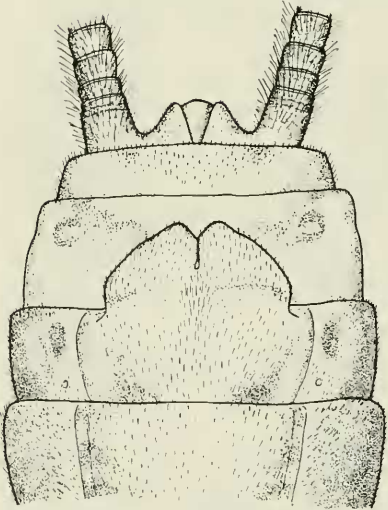
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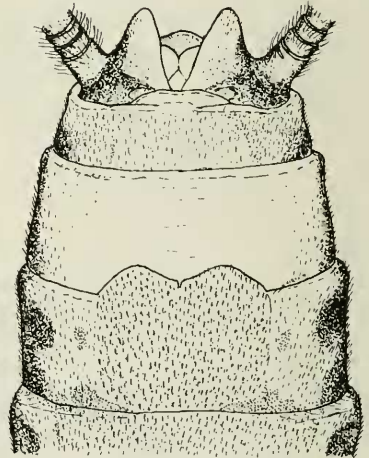
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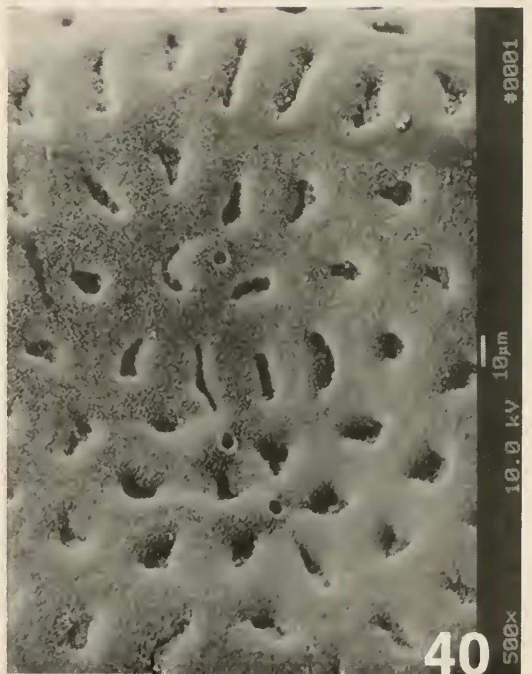
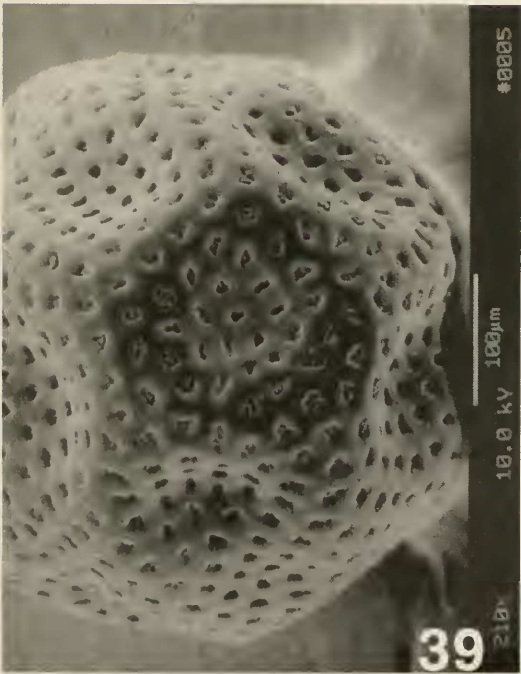
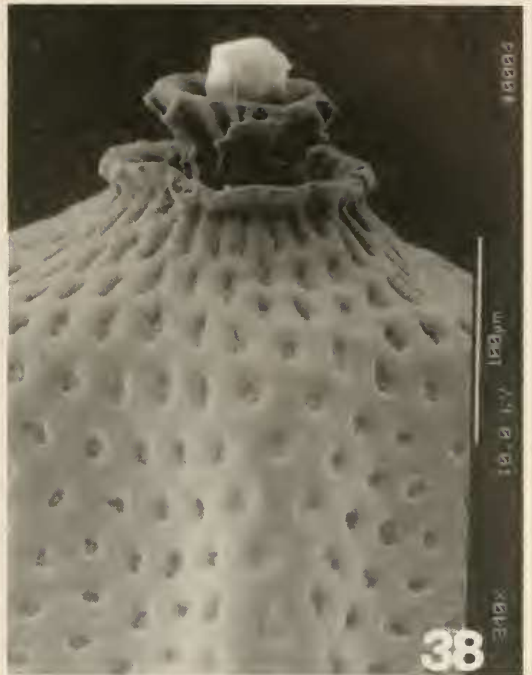


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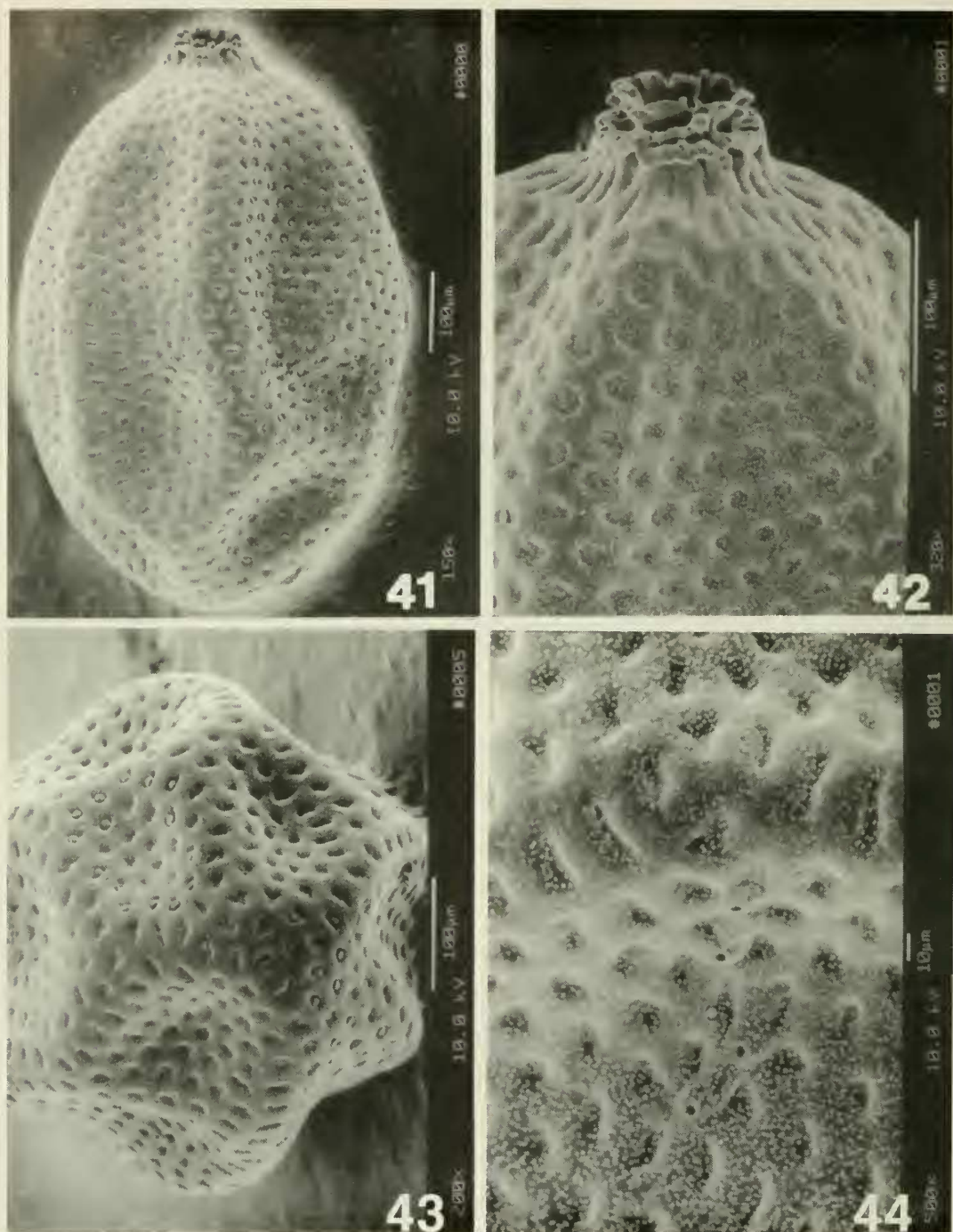


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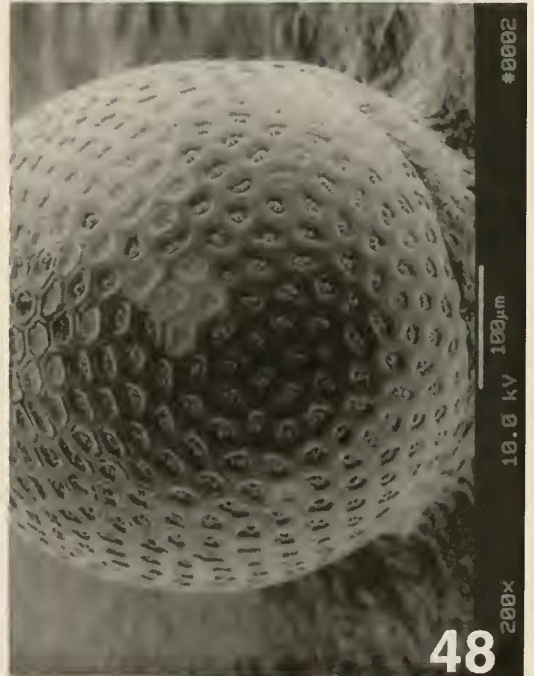
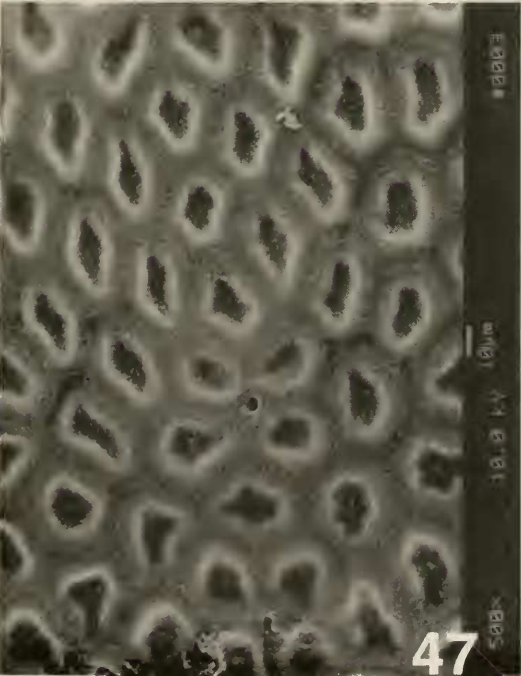
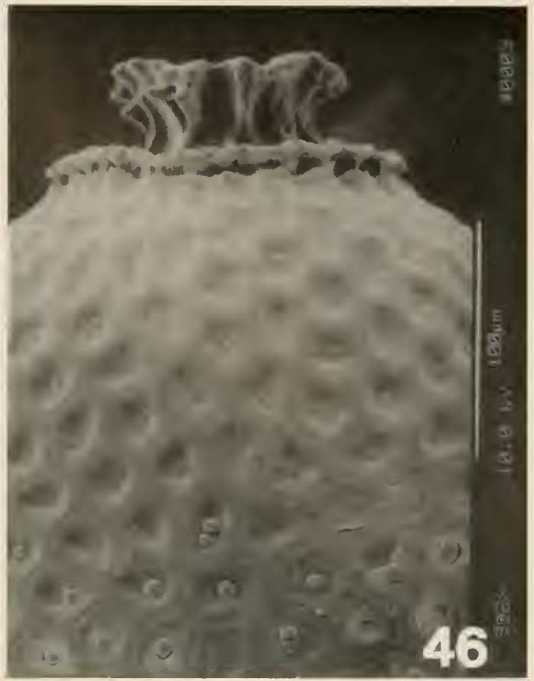
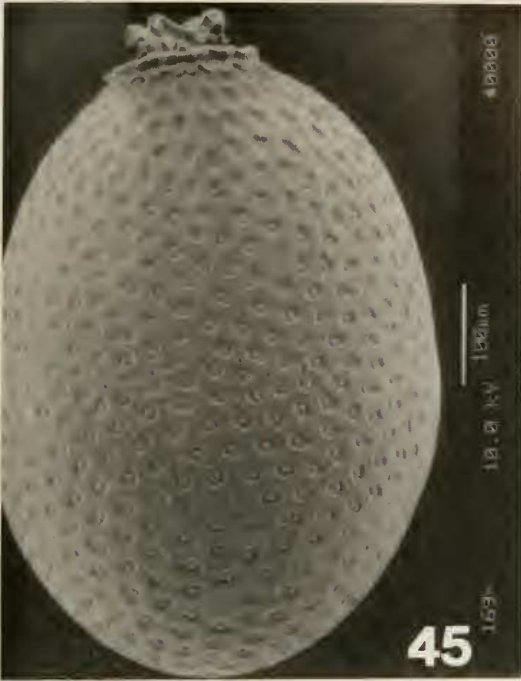
Figs. 32–36. Female subgenital plates, ventral. 32, *Megarcys signata*. 33, *M. yosemite*. 34, *M. watertoni*. 35, *M. irregularis*. 36, *M. subtruncata*.



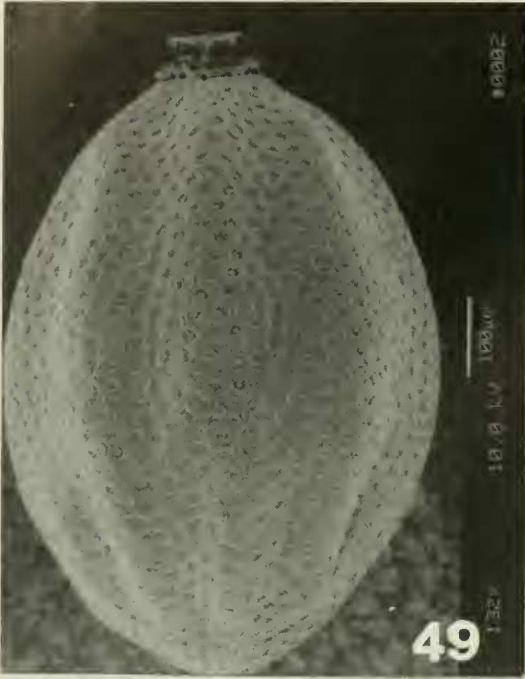
Figs. 37–40. *Megarcys signata*. 37, Egg, lateral. 38, Egg, lateral, anterior pole. 39, Egg posterior pole. 40, Chorionic detail, lateral.



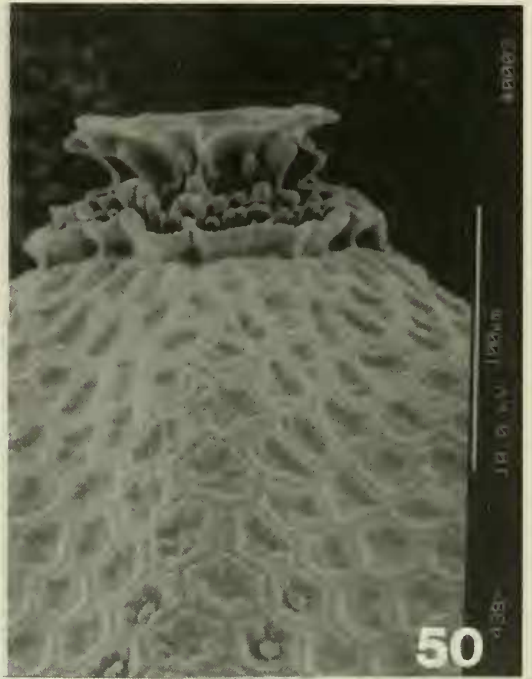
Figs. 41–44. *Megarcys subtruncata*. 41, Egg, lateral. 42, Egg, lateral, anterior pole. 43, Egg posterior pole. 44, Chorionic detail, lateral.



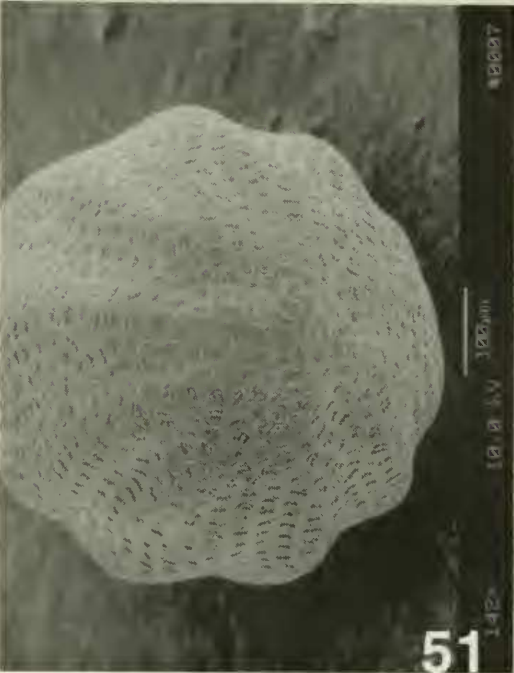
Figs. 45–48. *Megarcys irregularis*. 45, Egg, lateral. 46, Egg, lateral, anterior pole. 47, Egg posterior pole. 48, Chorionic detail, lateral.



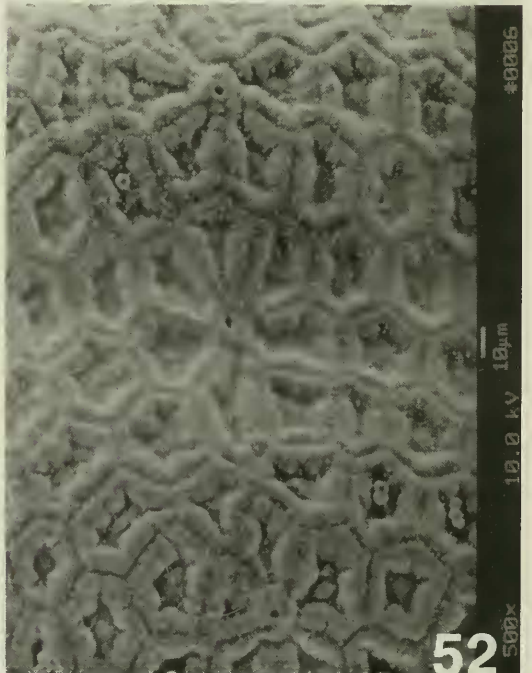
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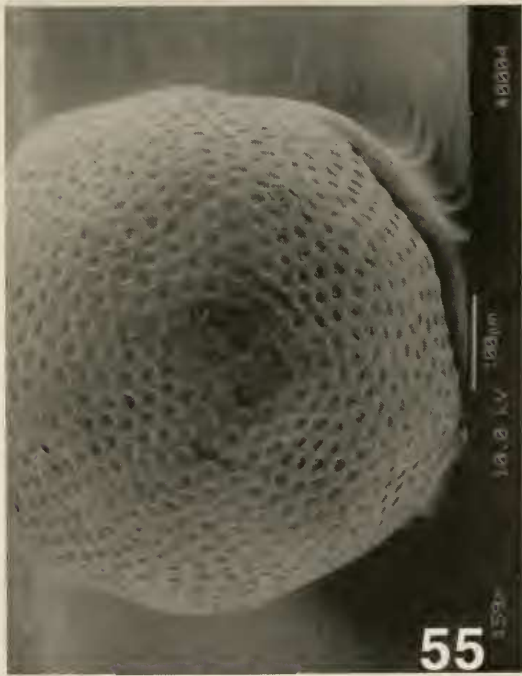
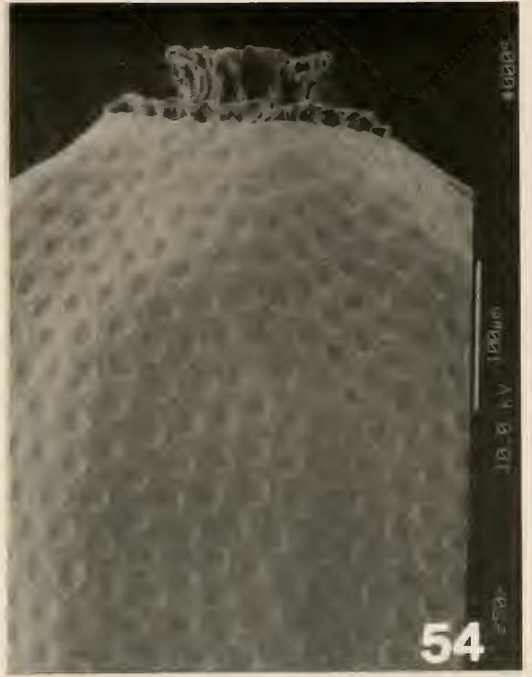


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Figs. 49–52. *Megarcys watertoni*. 49, Egg, lateral. 50, Egg, lateral, anterior pole. 51, Egg posterior pole. 52, Chorionic detail, lateral.



Figs. 53–56. *Megarcys yosemite*. 53, Egg, lateral. 54, Egg, lateral, anterior pole. 55, Egg posterior pole. 56, Chorionic detail, lateral.

range of all North American *Megarcys*. *Megarcys irregularis* is very similar to *M. signata*, indicating a recent species divergence from a common ancestor.

Material examined.—WASHINGTON: Pierce Co., Carbon R., at entrance Mt. Rainier N.P., 27 May 1997, B. Kondratieff, 8 ♂, 3 ♀ (CSU); Pierce Co., Nisqually R., Mt. Rainier N.P., 29 May 1997, B. Kondratieff, 2 ♂, 1 ♀ (CSU); Pierce Co., White R., Mt. Rainier N.P., 29 May 1997, B. Kondratieff, 8 ♂, 1 ♀ (CSU); Pierce Co., Tahoma Cr., Paradise Rd., Mt. Rainier N.P., 30 May 1997, B. Kondratieff, 2 ♀ (CSU); Pierce Co., Frying Pan Cr., Mt. Rainier N.P., 6 July 1999, B. Kondratieff, 1 ♀ (CSU); Pierce Co., Frying Pan Cr., Sunrise rd., Mt. Rainier N.P., 16 August 1999, B. Kondratieff, 1 ♀ (CSU).

Megarcys watertoni (Ricker)
(Figs. 20–24, 34, 49–52)

Arcynopteryx (Megarcys) watertoni Ricker 1952: 77. Type locality: Waterton Lake National Park, Alberta. Holotype ♂, CNC examined.

Megarcys watertoni: Illies 1966: 372.

Diagnosis.—The male of *M. watertoni* is very similar to *M. yosemite*, but can be best distinguished by the narrower and longer hemitergal lobes (Fig. 23) and the spinule pattern of the 9th tergum (Fig. 22). The female of *M. watertoni* is similar to *M. subtruncata*, but can usually be distinguished by longer plate length, at least ½ or more of 9th sternum (Fig. 34) and by the eggs, which are regularly folded and have hexagonal follicle cell impressions (Figs. 50–52). General color brown. Head with three light circular patterns, others between ocelli, near base of antennae; pale middorsal line on the prothorax (Fig. 20).

Male.—Length of fore wing 13–16 mm, body 17–21 mm. Posterior surface of epi-proct windsock-like with broadly rounded anterodorsal hump; apex tapered and de-curved at tip (Fig. 21). Ninth tergum swollen submedially, divided by median cleft,

spinules uniformly dense in cleft and on swollen areas (Fig. 22). Hemitergal lobes U-shaped with the posterior arm greater 2× longer than wide; posterior arm acute, twisted medially with spinules covering the anterior edge and sparsely covering the membrane of lobe (Figs. 21, 23). Lateral stylets blunt at apex, subequal in width with subacute process (Figs. 21, 24).

Female.—Length of fore wing 15–18 mm, body 16–21 mm. Subgenital plate prolonged to cover ½ or more of the 9th sternum, posteriorly rounded with small median notch not reaching the posterior margin of 8th sternum (Fig. 34).

Egg.—Collar stalked, rim usually deeply and irregularly incised; posterior surface of shoulder with ornate processes (Figs. 49, 50). Chorion covered with irregular hexagonal follicle cell impressions; walls of follicle cell impressions thick and constricted irregularly; surface with eight wide striae separated by sulci (Figs. 50–52); micropylar row subequatorial; eclosion line absent (Fig. 49).

Distribution.—Northern Rocky Mountains of AB, BC, ID, and MT (Stark 1998).

Remarks.—This species is often associated with small high elevation Northern Rocky Mountain streams.

Material examined.—CANADA: ALBERTA: Banff N.P., Red Earth Cr., Hwy 1, 20 miles N Banff., 2 July 1965, A.V. Nebeker, 10 ♂ (BYU); Banff N.P. Moraine Cr. Hwy 17 mi. S. of Lake Louise, 2 July 1965, A.V. Nebeker, 7 ♂ (BYU); BRITISH COLUMBIA: Kootenay N. P. Bridge on stream 3 mi. east of Radium jct. Hwy 93, 2 July 1965, A.V. Nebeker, 1 ♂ (BYU); IDAHO: Bonner Co., Granite Cr., Lake Pend Oreille., 15 May 1959, S.G. Jewett Jr., 4 ♂, 2 ♀ (BYU); MONTANA: Cascade Co., Belt Cr. 19 mi. S.E. of Monarch, 7 July 1966, J.R. Grievson, 1 ♂ (BYU); Flathead Co., Bear Cr. 5 mi. above jct. with M.F. of Flathead R., 24 June 1965, A.V. Nebeker, 3 ♂, 1 ♀ (BYU); Flathead Co., Cr. ½ mi. N. Essex Post Office, Hwy. 2., 6 July 1965, A.V. Nebeker, 6 ♂ (BYU); Flathead Co.,

Cr. 20 mi. E of W. Glacier, 6 July 1965, A.V. Nebeker, 3 ♂, 2 ♀ (BYU); Flathead Co., Doris Cr. 4 mi. S. of Hungry Horse Dam, 18 July 1965, A. V. Nebeker, 1 ♂, 1 ♀ (BYU); Flathead Co., Bear Cr. Hwy 2 Morias Pass, 18 June 1970, R.A. Haick, 1 ♂, 1 ♀ (BYU); Flathead Co., Glacier N.P. Fish Cr. above Fish Cr. Campground above Lake McDonald, 5 June 1996, R.S. Hansen and B. Ward, 2 ♀ (BYU); Glacier Co., Iceberg Cr., Glacier N.P., 30 August 1965, A.V. Nebeker, 1 ♂ (BYU); Glacier Co., Iceberg Cr., Many Glacier Campground., Glacier N.P., 29 July 1969, A.R. Gaufin, 3 ♂, 3 ♀ (BYU); Glacier Co., Waterton R., 23 July 1970, C. Tarmoloy, 1 ♂ (BYU); Glacier Co., Iceberg Cr., Glacier N.P., 28 July 1970, A.R. Gaufin, 1 ♀ (BYU); Glacier Co., Baring Cr. Sunrise Gorge, Glacier N.P., 22 July 1979, B. Stark, K. Stewart and R. Baumann, 5 ♂, 4 ♀, (BPSC); Granite Co., Ranch Cr. bridge, Rock Cr., 25 June 1966, M.L. Miner, 1 male, 1 ♀ (BYU); Granite Co., Ranch Cr. at Grizzly Campground., 19 June 1967, M.L. Miner, 1 ♂ (BYU); Missoula Co., N. fork of Elk Cr. at middle flume, 6 July 1970, M.L. Miner, 1 ♀ (BYU).

Megarcys yosemite (Needham and Claassen)

(Figs. 25–31, 33, 53–56)

Perlodes yosemite Needham and Claassen 1925: 56. Type locality: Mt. Lyell, Yosemite National Park, California. Holotype ♂, CU, examined.

Arcynoptergx (Megarcys) yosemite: Ricker 1952: 75.

Megarcys yosemite: Illies 1966: 371.

Diagnosis.—The male and female are very similar to *M. watertoni* and characters for separation are given in the diagnosis for *M. watertoni*. General color brown. Head with posterior dark patch to the anterior margin of the compound eyes, enclosing posterior ocellus, dark W-shaped pattern between compound eyes encompassing anterior ocelli (Fig. 25).

Male.—Length of fore wing 16 mm, body 21 mm. Posterior (ventral) surface of epiproct windssock-like, with a high, very broadly rounded anterodorsal hump, narrowing gradually distally with decurved apex (Fig. 26). Ninth tergum swollen submedially, divided by median cleft; spinules dense in cleft and along posterior edges of swellings (Fig. 27). Hemitergal lobes U-shaped, posterior arm $1\frac{1}{2}\times$ longer than wide, apex of distal arm acute, twisted medially, spinules covering anterior arm, sparsely on membrane (Figs. 26, 28). Lateral stylets widest distally, with acute spine (Figs. 26, 29). Aedeagus with rounded posterior end with small medial cleft, lateral filaments extended laterally, sclerotized patches laterally from the median dorsal lobe (Figs. 30, 31).

Female.—Length of fore wing 21–22 mm, body 17–20 mm. Subgenital plate triangulate, produced $\frac{1}{2}$ or more length of 9th sternum, lobes narrowly rounded at apex, with medial emargination extending to $\frac{1}{2}$ or more of plate (Fig. 33).

Egg.—Collar stalked, rim usually deeply and irregularly incised; posterior surface of shoulder with ornate processes (Figs. 53, 54). Chorion covered with hexagonal follicle cell impressions; having smooth thick walls; surface with shallow irregular indentations; posterior pole rounded (Figs. 54–56); micropylar row subequatorial; eclosion line absent (Fig. 53).

Distribution.—Cascade Mountains and Sierra Nevada Mountains of CA and WA (Stark 1998).

Remarks.—The holotype male consists of dissected terminalia and wings mounted on a single microscope slide. The male from Mt. Rainier agrees completely with the type in details of the epiproct, hemitergal lobes and lateral stylets. *Megarcys yosemite* is apparently rare, and is associated with high elevation small glacier fed-streams (Ricker 1952).

Material examined.—WASHINGTON: Pierce Co., Frying Pan Cr., Sunrise rd. Mt. Rainier N.P., 16 August 1999, B. Kondra-

tieff, 1 ♂, (CSU); Creek at high elevation from interglacier and tribs. near White R., Mt. Rainier N.P., 26 July 1953, W. E. Ricker and A. Ricker, 2 ♀, (INHS); Whatcom Co., Coleman Glacier, Mt. Baker, 23 July 1988, R. Pollock, L. Jones, 1 ♂, 4 ♀ (BYU).

KEYS TO NORTH AMERICAN SPECIES OF *MEGARCYS*

Males

1. Hemitergal lobe apices acute (Figs. 11, 23, 28) 2
- Hemitergal lobe apices blunt (Figs. 4, 16) 4
2. Spinules covering most of distal portion of the hemitergal lobe; lateral stylet truncate apically (Figs. 9, 12); Coast and Cascade Mts
. *M. subtruncata*
- Spinules only at anterior portion of distal hemitergal lobe; lateral stylet tapered apically (Figs. 23, 24, 28, 29) 3
3. Hemitergal lobe narrow, 2× longer than wide; epiproct sack arising near apex (Figs. 21, 23), Northern Rocky Mts *M. watertoni*
- Hemitergal lobe wide, 1½× as long as wide; epiproct sack arising at mid-length (Figs. 26, 28); Cascade and Sierra Nevada Mts
. *M. yosemita*
4. Spinules absent from median cleft of 9th tergum, sometimes a few scattered spinules (Fig. 15); Coast and Cascade Mts *M. irregularis*
- Spinules in the median cleft of 9th tergum (Fig. 3); Rocky Mts. *M. signata*

Females and Eggs

1. Subgenital plate with deep median notch, distinctly separating lobes to, or beyond, posterior margin of 8th sternum (Figs. 32, 35) 2
- Subgenital plate with shallow median notch present or absent, if present not distinctly separating lobes to the posterior margin of 8th sternum (Figs. 33, 34, 36) 3
3. Subgenital plate produced ½ or more length of 9th sternum (Fig. 32); posterior pole and egg surface irregularly indented, chorion covered with irregular deep pits without obvious hexagonal pattern (Figs. 37–40); widespread along the Rocky Mts. *M. signata*
- Subgenital plate produced ½ or less length of 9th sternum (Fig. 35); chorion covered with shallow pits surrounded by hexagonal follicle cell impressions (Figs. 45–48); Coast and Cascade Mts. *M. irregularis*
4. Subgenital plate triangulate, produced ½ or more length of 9th sternum, lobes narrowly

- rounded at apex, medial notch narrow, extending ½ or more of plate (Fig. 33); egg surface indentations superficial, chorion covered with rather uniform, smooth walled hexagonal follicle cell impressions surrounding shallow bowl shaped pits (Figs. 53–56); Cascade and Sierra Nevada Mts. *M. yosemita*
- Subgenital plate rounded, medial notch, extending ¼ or less of plate (Figs. 34, 36) 4
 - 5. Subgenital plate covers less than ½ of 9th sternum, (Fig. 36); egg surface indentations prominent, chorion covered with irregular deep pits without obvious hexagonal pattern (Figs 41–44); Coast and Cascade Mts. *M. subtruncata*
 - Subgenital plate covers ½ or more than half of 9th sternum (Fig. 34); egg surface indentations prominent and arranged in regular striae and sulci, chorion covered with hexagonal follicle cell impressions (Figs. 49–52); Northern Rocky Mts. *M. watertoni*

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